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ABSTRACT

The influence of students' behavioral definitions on subsequent teacher behaviors was investigated with a simulation which allowed teachers using a microcomputer and video display terminal to verbally interact with four simulated students programmed to vary on knowledge and initiative. These "students," in turn, responded to teacher questions and asked questions on their own. The stability of teacher behavior within a simulation, differences among teachers in their use of positive affect as a consequence, and global changes in teacher patterns within the simulation were specifically addressed. Subjects were 40 teachers enrolled in the University of Virginia School of Education, who were divided into four subgroups representing factorial combinations of training area and experience. During two 20-minute sessions, teachers individually conducted a spelling lesson by instructing, questioning, calling on students, or using other appropriate behavior. Results indicated individual teacher patterns were quite consistent. High-knowledge students received more positive affect, overall, as a consequence than their low-knowledge classmates, with the quiet high-knowledge students rewarded relatively most often. As a group, teachers demonstrated changes in behavior over time, indicating a move toward relatively greater emphasis upon instruction and teacher-determination of targeted students. Results of the study indicate that the simulation influenced teacher behavior in a logical and predictable manner. Five references and two tables are included. (LMM)

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COMPUTERS AS LABORATORY APPARATUS TO EXAMINE TEACHER-STUDENT INTERACTIONAL BEHAVIOR

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Computers as Laboratory Apparatus to Examine Teacher-Student Interactional Behavior

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Any effective teaching model is fundamentally concerned with reciprocal student-teacher interactions. A cyclical view of such interactions suggests that student and teacher behaviors concurrently impact on each other. Unfortunately, current conventional methodologies have not allowed researchers to assess adequately the continuing impact of students' behaviors upon subsequent teacher behavior. Recent advances in microcomputer technology, however, now afford the opportunity for (1) simulating realistic "student" participants whose behaviors are researcher defined and (2) recording and tabulating the ongoing student-directed behavior of the teachers who instruct such "simulated" students.

A basic concern in initially pursuing such research is to determine whether "simulated" students constructed to possess constrasting behavioral repertoires can evoke different response patterns in their teachers. This question was the theme of an investigation recently conducted by the present authors. This paper presents selected evidence from this investigation. Specifically this paper describes the overall investigation, and

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presents results concerning the stability of teacher behavior within the simulation, differences among teachers in terms of their use of positive affect as a consequence, and global changes in teacher patterns within the simulation.

METHOD

Subjects

Subjects included 40 student teachers enrolled in the School of Education at the University of Virginia. These "teachers" were divided into four subgroups (N=10 each) representing factorial combinations of training area (Special Education vs. General Education) and experience (0 years teaching vs. 5 or more years teaching).

Procedure

The simulation was achieved through the use of an Ohio Scientific Institute Challanger II microcomputer; the program was written in BASIC (Strang, 1982). The simulation was designed to allow teachers to verbally interact with four simulated students, who in turn responded to teacher questions, and asked questions on their own. The simulated students were programmed to vary on two factors: knowledge, operationally defined as the probability that a student would respond with a correct answer to a teacher question, and initiative, operationally defined as the probability that a student would raise his hand in anticipation of answering or questioning the teacher. The probability levels were set to either .90 (high) or .10 (low). A four student class was constructed to represent the four factorial combinations of initiative and knowledge.

The simulation exercise consisted of having a teacher sit in front of a 19-inch video display in a sound proof booth. The teacher was told, via an intercom, to look at the screen, at which time four student names appeared. These names represented four male students. The teacher was instructed concerning the meaning of the simulation symbols (e.g., a flashing asterisk next to a child name indicated that the child was raising his hand). The teacher was then told to conduct a class, using the material provided (a spelling list that was assigned to the children for homework). Teachers were encouraged to instruct, question, call on students, or do whatever they felt was appropriate. Class sessions lasted 45 minutes, with two 20-minute sessions separated by a five minute break. This design resulted in three levels of within-subjects variables. These were: Phase (first 20 minutes vs. second 20 minutes), Knowledge (behavior towards high knowledge children vs. low knowledge children), and Initiative (behavior to high initiative children vs. behavior toward low initiative children).

As the teacher conducted the class, an operator coded the teacher trainee behavior according to predetermined code; a value was keyed into the microcomputer video-terminal as soon as the behavior occurred. A second operator verbally relayed the student response to the teacher via an intercom. The content of these responses was determined by the computer and then displayed on the operator's video-monitor.

Description of the Behavioral Cycles

Behaviors were coded as cycles representing a sequence of: Stage 1, an Antecedent teacher behavior; Stage 2, a computer determined student response; Stage 3, a consequating teacher behavior.

Stage 1: Antecedent Teacher Behavior

Antecedents were divided into three main categories depending upon whether the teachers' behavior was directed at a teacher-selected child, a volunteer who had raised his hand in class, or the class in general (no specific child).

The teacher-selected child antecedents included:

Teacher Questions Specific Child - Teacher asked a particular child a question.

Teacher Repeats - Teacher requested a particular child to repeat a particular resonse after the teacher.

Teacher Gives Obvious Question - Teacher asked a particular child a very obvious question (e.g., "Have you every been to the park?").

The volunteer-directed child antecedents were:

Teacher Solicits Questions - Teacher asked the class if there were any questions, and called upon a child who volunteered a question. The probability that a child would volunteer was dependent on the initiation level of the child.

Teacher Solicits Answers - Teacher asked the class if anyone knew the answer to a particular question and called upon a child who volunteered an answer. The probability that a child would volunteer was determined by the initiative level of the child.

Teacher Calls on Unsolicited Child Question - Teacher called on a child, who unsolicited by the teacher, raised his hand to ask a question. The probability that a child would volunteer was determined by the initiative level of the child.

The class directed antecedent was coded whenever the teacher initiated a cycle by delivering instruction or commenting to the class in general. This instruction placed no demand on any particular child in the class, and therefore the cycle could not be completed using the consequence code described below. However, the behavior was recorded and treated as a unique cycle.

Stage 2: Computer Determined Student Response

The content of individual child response was dictated by the simulation itself. The verbal content of the response was relayed to the teacher via an intercom by the second operator who served as the "voice" of the simulated children.

Possible child responses included:

Correct answer - The child correctly responded to a teacher question. The occurrence of a correct answer was determined by the knowledge level of the child.

Incorrect answer - The child incorrectly responded to a teacher question. Incorrect spellings were determined for each word in the spelling list. The incorrect spellings represented a violation of one of four orthographic rules. The specific misspellings were determined prior to the simulation; the selection of a particular misspelling of a word was random. The occurrence of an incorrect answer was determined by the knowledge level of the child.

Obvious answers - If a teacher requested a very obvious response, the child always responded correctly.

Repeats - If a teacher requested a child to repeat a response verbatim, the child correctly repeated the response.

Child questions - When the simulation so required, the child would ask a question. The rule for formation of the question dictated that the question relate to the most recent spelling word mentioned by the teacher. The question was either a) a request for a specific spelling, b) a request for the teacher to use the word in a sentence, or c) a question concerning the relevant orthographic rule.

On very rare occasions teachers requested a child behavior not covered by any of these contingencies (e.g., "Chris, would you put your finger on the second word.") In any such case, the child would respond in compliance with the teacher request. These cycles were noted, but not included in the analysis.

Stage 3: Consequating Teacher Behavior

The consequences were determined by coding how the teacher consequated the student responses. This input addressed three dimensions. The three dimensions, combined factorially, resulted in 12 possible consequence configurations. The dimensions were as follows:

Instruction - Teacher gave student some curricular information concerning the lesson in question.

Feedback - Teacher explicitly told the student whether his response was correct or incorrect.

Affect - The general affective level accompanying an interaction. Positive affect was indicated by a marked elevation in affect accompanied by praise; neutral affect was indicated by a normal level of affect; negative affect was indicated by a marked elevation in affect accompanied by criticism.

The three dimensions were combined factorially, with every dimension coded on each cycle. At the completion of each cycle, the first operator keyed in the presence or absence of instruction, the presence or absence of feedback, and the level of affect. This resulted in 12 possible consequating configurations, and independent scores for each of the three dimensions.

Dependent Variable

It should be noted that in several categories of the coding scheme, simple frequencies could be expected to be inflated by the initiative variable. The design of the simulation itself was structured such that high initiative children were more likely to be involved in student-teacher interaction cycles. For this reason, where appropriate, separate analyses of behavioral data were conducted, using as dependent variable both raw frequencies of behaviors, and behavioral proportions. In the latter case proportions were computed as follows: the number of times a teacher employed a specific behavior with a particular child was divided by the total number of interactions the teacher had with the child in question.

After completion of the 45-minute simulation experience, teachers were asked to complete a questionnaire evaluating each student in their simulated class. This data afforded information concerning the impact of the simulation on teacher perceptions.

RESULTS

The results presented in this paper addressed three areas: These were 1) stability of teacher behaviors within the simulation; 2) differences in teachers' use of positive affect as a consequence; and 3) global teacher changes throughout the simulation. Additional results concerning other teacher overt behavior (behavioral data) and perceptions (questionnaire data) will be presented in future publications.

Stability Within Simulation

In order to assess stability of individual teachers' behavior patterns, total frequencies of teachers' use of antecedent and consequating behaviors in each of the two phases were subjected to correlational analyses. Results indicated extremely stable patterns for all of the variables (Table 1).

Positive Affect Consequence

Affect coding yielded three affect designations: positive affect, neutral affect, and negative affect. Inspection of the raw data indicated that negative affect was an extremely low frequency occurring event. More typically, teachers employed either positive affect, or neutral affect. For this reason, affect was treated as a dichotomous category with behaviors considered to represent either positive affect or non-positive affect (neutral or negative affect).

The design of the experiment enabled a molecular view of teacher behavior by considering the two between subjects variables (Training and Experience) and the three within-subjects variables (Knowledge, Initiative, and Phase). A split-plot factorial ANOVA was conducted to examine, in depth, the teachers use of positive

affect. Proportion scores, as previously described, were used. Table 2 presents the average mean proportions for relevant variables, as well as the raw frequencies upon which the proportions are based.

Results indicated a significant knowledge effect ($F=123.66$, $df=1,36$, $p < .001$). Teachers were far more likely to use positive affect in consequating students who responded correctly than in consequating students who responded incorrectly. A significant initiative effect was also found ($F=13.72$, $df=1,36$, $p < .01$): teachers were more likely to use positive affect in consequating low initiative students than in consequating high initiative students. This main effect was mediated by an interaction between Initiative and Knowledge ($F=6.43$, $df=1,36$, $p < .05$). Post-hoc analysis indicated that while initiative had no bearing on positive affect in low knowledge students, it considerably altered the proportions of positive affect given to high knowledge students. Among high knowledge children, the low initiative child was more likely to receive positive affect than was the high initiative child. Neuman-Keuls analysis revealed a value of 4.4 for this contrast, beyond the critical value for a .01 level of significance. No other significant main or interaction effects were found.

Global Changes Within Simulation

While the stability correlation coefficients indicated that teachers as a group were extremely consistent in their use of particular behaviors, t-tests applied to Phase I and Phase II dependent measures revealed global group trends across the phases. Specifically, in Phase 2, teachers were less likely to engage in

in interactions which were directed at class volunteers ($t=2.60$, $df=39$, $p < .05$), and were more likely to employ general class directed instruction ($t=2.38$, $df=39$, $p < .05$). In a similar vein, teachers increased their use of instruction as a consequence in Phase 2 ($t=2.36$, $df=39$, $p < .05$). Collectively these results indicated a general trend for teachers, as a group, to become more directive in their teaching over the course of the simulation experience.

DISCUSSION

The major question in the present investigation concerned whether simulated students' behavioral definitions influenced subsequent teacher behaviors. Before addressing the issue of teachers variations in their behavior, however, it was essential to demonstrate that individual teaching patterns were stable over time. Results from the correlational analysis of Phase 1 and Phase 2 behaviors indicated teacher patterns to be quite consistent. Individual teachers' relative standing to other teachers, in terms of usage of targeted behaviors, remained essentially unchanged across the two phases.

The effect of students' behavioral definitions upon teachers' use of positive affect was directly examined. Results indicated that high knowledge students received more positive affect as a consequence than did their low knowledge classmates. Such a tendency for high knowledge children to receive more positive affect from teachers has been consistently reported by natural observation studies (Brophy, 1981; Good & Brophy, 1978). Interestingly, although teachers in the simulation tended to give more positive affect overall to high knowledge students, they apeared to reward the

"unassuming, quiet" high knowledge students relatively more than the high knowledge students who persisted in volunteering questions and answers. Several possible interpretations suggest themselves. It may be that teachers felt more in control of the low initiative-high knowledge children, and thus rewarded them proportionately more(Cooper, 1977; Cooper, Hinkely, & Good, 1980). Among similar lines, it may be that teachers wished to encourage these unassuming high knowledge students to participate more actively. Further research into the basis of this teacher behavior is indicated.

As a group, teachers demonstrated changes in behavior over time. The pattern of these global changes indicated a move toward relatively greater emphasis upon instruction and teacher-determination of targeted students. This pattern suggested that, as a group, teachers became more directive with exposure to the simulation. Moreover the directiveness appeared to mirror the simulation variables: As teachers became more aware of the knowledge limitation of students in their class, they employed more direct instruction; as teachers became more aware of the different levels of initiative in students in their class, they allowed fewer interactions with relied upon volunteers.

These results indicate that the simulation impacts teacher behavior in a logical and predictable fashion. These results, as well as others currently under analysis argue the benefits of computers as laboratory apparatus. Computer simulation holds promise of becoming a very powerful tool for the study of behavior. It combines the best of the two existing methods of researching behavior: the lab analogue experiment which permits the

experimenter to artificially control specific variables, but suffers problems of ecological validity, and behavioral observation which enjoys the richness and authenticity afforded by non-intrusive observation, but is beset with difficulty in controlling extraneous variables.

A major criticism that can be expected of any computer simulation is that it is not "real". An appropriate response to this is that it may not be necessary or desirable to duplicate a total reality in order to yield valid information about "real" variables. On the contrary, the opportunity provided by the simulation to experimentally control student behaviors while allowing teachers to perform the actual behaviors used in teaching, is an outstanding advantage.

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Table 1

Behavior Patterns Across Phases of Simulation

Variable	Phase 1 Average Cycle Frequency	Phase 2 Average Cycle Frequency	Correlation of Phase 1 and Phase 2	T-Test for Difference Phase 1 vs. Phase 2
Antecedents				
Cycle directed toward:				
Teacher-specified child	31.60	32.70	.73**	-.69
Volunteer specified child	12.00	10.30	.81**	2.60*
Class (no child specified)	6.75	8.27	.72**	-2.38*
Consequences:				
Instruction	12.65	14.40	.71**	-2.36*
Positive Affect	16.08	15.03	.63**	1.00
Feedback	16.08	17.13	.63**	-.84
Total Cycle Count	50.4	51.5	.75**	-.78

*$p < .05$
**$p < .001$

Table 2

Summary of Means for Significant Effects -- Positive Affect Consequence[1]

Knowledge

Low	High
.25 (3.03/12.12)	.56 (4.74/8.46)

Initiative

Low	High
.44 (3.49/7.93)	.37 (4.28/11.57)

Knowledge by Initiative

	Low	High
Low	.26 (2.71/10.42)	.61 (4.26/6.98)
High	.12 (3.35/14.57)	.50 (5.21/10.42)

[1]Reported means are proportions based upon raw frequency of occurrence of the targeted behavior for a given child divided by the total number of interactions for a given child. Raw frequencies are reported in parentheses.